

REMARKS

I. *Prosecution History and Status of the Case*

This case is a continuation of serial number 08/745,380 filed November 8, 1996 ("the parent case"). The parent case was filed with 29 claims. All twenty nine of those original claims are hereby cancelled. Claims 30-39 are added. Claims 30 – 39 are now in the case.

II. *Applicants' Invention*

Applicants' invention is directed to a time-division-multiplexed (TDM)-based fixed wireless loop system. Such a system is advantageously arranged in a plurality of "cells," each of which contains a base station and a multiplicity of non-mobile terminals. The base station of a given cell generates antenna "beams" for receiving transmissions from terminals within the cell and generates other antenna beams for transmitting to terminals within the cell.

Communications in the present system occur in allocated periods of time known as "time slots." Time slot allocation and other base station activities are regulated by a cell controller that is associated with each base station. Time slots are advantageously allocated based on prevailing system interference. Such interference is caused by "in-cell" and "out-of-cell" communications, both of which are advantageously considered in the allocation method.

A. *Considering the Effect On Active Links of Granting a Request for Air-Time*

A request by a terminal for access to the "air" is denied unless suitable transmit *and* receive time slots are found. A "transmit" or "downlink" slot is a time slot that is used for base station transmissions to a terminal, while a "receive" or "uplink" slot is a time slot that is used for terminal transmissions to a base station. A suitable transmit slot is defined in the Specification as a slot in which:

1. the interference level at the terminal receiver due to other in-cell and out-of-cell transmit beams on the same time slot is low enough for satisfactory reception; and
2. the transmit beam on that slot does not render *other links* unsuitable.

A suitable receive slot is defined in the Specification as a slot in which:

1. the interference level at the base station receiver due to other in-cell and out-of-cell transmitting terminals is low enough to allow satisfactory reception; and
2. transmission on the selected slot will not render *other links* unsuitable.

B. Inter-Cell Coordination

As already discussed, in some embodiments, a cell controller estimates whether a requesting terminal's transmission affects other base stations that are in the process of receiving signals from other terminals. Since such other base stations are (by definition) located in different cells, such a determination requires that the cell controller of a given cell has access to information concerning interference levels in links located in other cells.

In embodiments of applicants' invention in which inter-cell coordination is used, each cell controller collects real-time data from "neighboring" cell controllers about activities in those cells (*i.e.*, what links are on-the-air) and shares with them information regarding the activity in its own cell. Applicants' Specification describes the data that is to be exchanged and the manner in which it is used to allocate time slots (among other functions). *See, spec. at p. 15-29.*

C. An Archive of Mutual Interference Levels

When the system is commissioned, and, advantageously, at periodic intervals thereafter, the mutual interference levels between *every potential pair of communications links in the system* is measured and archived in a database. Such data is used to estimate the interference levels caused by and experienced by the requesting link during a time slot under consideration. The archived interference levels are used in conjunction with links that are active for the time slot under consideration. The manner in which the database is formed, the data contained therein, and the manner in which such data is used is described in the Specification at pages 16-25.

Restating the foregoing for emphasis, in applicants' invention, interference levels are *not obtained in real time*. It would be impossible, at least with present technology, to evaluate, in real time, all the interference sources that are considered by applicants' invention. First, a potential caller would hang up long

before the system could determine if and when their request for access to the air could be granted. Second, to obtain the type of data that applicants utilize, links that were “on-air” would have to be terminated so that individual interference contributions could be determined. Clearly an unworkable approach.

The use of such archived data is only possibly because the invention is directed to a *fixed* system. Such an approach is obviously not feasible in a mobile system since interference levels are continually changing as mobiles change their position.

In addition to using the archived mutual interference values to estimate total interference levels for the purpose of slot allocation, in some embodiments, such data is used by a cell controller to *alter its uplink beams* for the purpose of minimizing, to the extent practical, interference caused by a new communications link. A cell controller may likewise decide to *alter its downlink beams* to protect a new communications link from strong interferers. Modifying the uplink and downlink beams in this manner is possible because of *the pair-wise mutual interference levels that are stored in a cell controller’s database*. In some prior art systems, a real-time total interference measurement is obtained. But a total interference value is useless for determining how to modify an antenna beam (*i.e.*, radiation pattern) to protect a new link from a *specific* strong interferer, or to protect another link from the new link. Such modification of downlink and uplink beams is described in the Spec. at page 24, line 17 – page 27, line 12; page 29, lines 4-21; page 34, line 10 – page 42, line 13.

Thus, the novel features of applicants’ invention discussed above (there are others) include:

1. Before allocating two time slots (*e.g.*, uplink and downlink) for communications, interference levels at the requesting terminal and the first base station (due to other links sharing the same time slot) must be estimated and found to be acceptable, and the estimated interference levels at other links due to the requesting link coming on-the-air must also be acceptable.
2. Using inter-cellular communication/coordination between cell controllers.
3. Modifying uplink antenna beams to protect other active links and modifying downlink antenna beams to protect a new link.
4. The mutual interference level between every potential pair of communications links in the system is measured and archived in a database to as the basis for interference calculations and slot allocation.

Such novel features, which are not disclosed or even suggested by the prior art, are recited in claims 30-39, now presented for examination.

**III. *Claims 30 - 39 are in
Condition for Allowance***

The art cited in the parent case included U.S. Pat. No. 5,313,461 to Ahl et al., and a reference to Zander et al. It is believed that claim 30-39 are allowable over these references.

Ahl et al. is directed to a method for solving a "certain connection requirement" within an area or a space of a certain geographical region. The method is implemented by connecting three or more connection terminals of independent or dependent connection points to a common communication resource. Dynamically, according to a subscribers' traffic requirements, only such information in each connected signal as is necessary for each individual service to be communicated through the communications system is communicated. According to the patent, the method provides more efficient bandwidth utilization and is less sensitive to interference.

The Examiner alleges that Ahl et al. disclose a system for connecting two or more peripheral stations to a central station. The Examiner further alleges that Ahl et al. disclose all the subject matter of the claimed invention with the exception of allocating slots using the interference in a communications network. According to the Examiner, the Zander et al. article teaches "interference analysis," and finds that it would have been obvious to allocate time slots based on such interference considerations.

Applicant's agree with Examiner that Ahl provides no teaching concerning slot allocation, which is a key aspect of applicants' method. Applicants' disagree with the statement that Ahl et al. "disclose all the subject matter of the claimed invention except ..." Fairly read, Ahl et al. appears to provide little if any disclosure relevant to applicants' claimed invention.

Zander et al. address the questions of what is the capacity (*i.e.*, how many terminals can talk at the same time) of a particular idealized system. Zander et al. assume that each central station (base station) generates antenna beams having "ideal 'pencil beam' shape." Zander et al. further assume that the main beam of each station does not overlap that of any other station. Zander et al. also assume that there is no inter-cell communication or coordination. (*See* Zander et al. at p. 535: "we will assume that the slot allocation in different cells is not co-ordinated.")

The “interference analysis” disclosed by Zander et al. (p. 535) and referenced by the Examiner is an analysis of two interference situations that arise given their idealized system. The first situation is when a peripheral station (*e.g.*, a terminal in a first cell) receives interference from a remote base station (*e.g.*, a base station in a second cell). The second situation is when a central station (*e.g.*, a base station in a first cell) receives interference from peripheral stations (*e.g.*, terminals) in other cells. These situations arise expressly because there is no inter-cell coordination.

Zander et al. determine, for those situations, an expression for the signal to interference ratio for an arbitrary (and randomly assigned) time slot. That information is used, in Section 5 of the article, to estimate system capacity (*see*, p. 536-537; and Figs. 4-8). The combination of Ahl and Zander do not obviate applicants’ claimed invention because:

1. There is no disclosure in either reference concerning the claimed limitation of *time slot allocation*. (*see, e.g.*, claims 30, 37, 38). In fact, it is expressly indicated in Zander et al. that:

“[a]n important topic for further research is the design of slot-allocation algorithms. In the study above, the assumption is made that slot assignments are uncoordinated, and interference appears ‘randomly.’” (p. 537.)

2. There is no disclosure in either reference concerning the claimed limitation of *inter-cellular coordination* (*see, e.g.*, claim 33). In fact, it is expressly indicated in Zander et al. that:

“we will assume that the slot allocation in different cells is not co-ordinated.” (p. 535)

3. There is no disclosure or suggestion in either reference concerning the claimed limitation of generating antenna beams to optimize the signal-to-total-interference ratio, or how that could be done (*see, e.g.*, claims 34-36). Indeed, it is expressly indicated in Zander et al. that:

“the radiation patterns of the antennas used have ideal “pencil beam’ shape.” (p. 534)

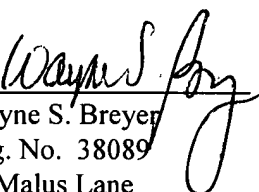
4. There is no disclosure in either reference the claimed limitation of using previously-obtained measurements of interference (*see, e.g.*, claims 31, 33), or accessing a data base comprising data indicative of mutual interference levels between every potential communications link within said fixed wireless loop system (*see, e.g.*, claim 32) or accessing archived mutual interference data (*see, e.g.*, claim 37).

As such, either alone or in combination, the cited art cannot be considered to disclose, suggest or even hint at the claimed embodiments of applicants' novel method for operating a fixed wireless loop system.

It is submitted that claim 30-30 are in condition for allowance. A notice to that effect is solicited.

Respectfully,

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